CLAIM AMENDMENTS

1. (currently amended) A zero excess bandwidth modulation method, the method comprising:

encoding a plurality of information bits, thereby generating a plurality of encoded bits;

puncturing at least one of the plurality of encoded bits thereby generating a non-punctured plurality of bits that includes a first bit followed by a second bit;

rearranging an order of the non-punctured plurality of ~~encoded~~ bits so that the second bit is followed by the first bit, thereby generating a sequence of discrete-valued modulation symbols;

TH (Tomlinson-Harashima) precoding of the sequence of discrete-valued modulation symbols according to a predetermined overall channel symbol response having spectral zeroes at edges of a corresponding Nyquist band, thereby generating a plurality of discrete-time transmit signals at a modulation rate;

inserting the plurality of discrete-time transmit signals into means to generate a continuous-time transmit signal by appropriate discrete-time filtering, digital-to-analog conversion (DAC), and continuous-time filtering;

ensuring, within the means to generate the continuous-time transmit signal, that the continuous-time transmit signal has spectral zeroes at the edges of the corresponding Nyquist band, which equals a bandwidth of the available transmission band, and that any spectral components outside of the available transmission band are substantially suppressed; and

launching the filtered, continuous-time transmit signal into the communication channel.

2. (original) The method of claim 1, wherein:

the predetermined overall channel response is characterized as $h(D) = 1 + h_1 D + h_2 D^2 + \cdots$;

$D = e^{-j2\pi fT} (= z^{-1})$;

f is frequency;

T is an inverse of the bandwidth of the available transmission band;

h_1, h_2, ... are constant valued coefficients; and

$h(D)$ is zero when $D = -1$.

3. (currently amended) The method of claim 1, wherein the encoding of the plurality of information bits further comprises:

mapping the rearranged non-punctured plurality of ~~encoded~~ bits into a plurality of modulation symbols according to a symbol constellation and a corresponding mapping function, thereby generating the sequence of discrete-valued modulation symbols.

4. (currently amended) The method of claim 1, wherein the encoding of the plurality of information bits further comprises:

encoding a subset of information bits of the plurality of information bits into the plurality of encoded bits; and

mapping the rearranged non-punctured plurality of ~~encoded~~ bits and at least one uncoded information bits into a plurality of modulation symbols according to a symbol constellation and a corresponding mapping function, thereby generating the sequence of discrete-valued modulation symbols.

5. (original) The method of claim 1, wherein:

TH precoding operates on the discrete-valued modulation symbols to perform an inverse filtering operation in accordance with the predetermined overall channel symbol response and executes modulo operations to limit signals within a predetermined signal region, thereby generating the plurality of discrete-time transmit signals at the modulation rate.

6. (original) The method of claim 1, wherein:

the sequence of discrete-valued modulation symbols has a modulation type of at least one of PAM (pulse amplitude modulation), QPSK (quadrature phase shift keying), 16 QAM (quadrature amplitude modulation), and a higher-order QAM.

7. (original) The method of claim 1, wherein:

the encoding of the plurality of information bits thereby generating the sequence of discrete-valued modulation symbols involves at least one of uncoded modulation, TCM (trellis coded modulation), TTCM (turbo trellis coded modulation), LDPC (low density parity check) encoding and modulation, and concatenated encoding and modulation.

8. (original) The method of claim 1, wherein:

the method is performed cooperatively within a communication transmitter and a communication receiver that are communicatively coupled via the communication channel.

9. (original) The method of claim 1, further comprising:

receiving a continuous-time receive signal from the communication channel;

converting the continuous-time receive signal into a discrete-time signal by means to perform appropriate continuous-time filtering, ADC (analog-to-digital conversion), and discrete-time filtering, thereby obtaining a plurality of discrete-time receive signals at the modulation rate;

ensuring, within the means to perform appropriate continuous-time filtering, ADC, and discrete-time filtering, that any signal and noise components outside of the available transmission band is suppressed and that the discrete-time receive signal is shaped into a form corresponding to the predetermined overall channel symbol response that is assumed for the TH precoding, and

decoding the plurality of discrete-time receive signals to generate best estimates of the sequence of discrete-valued modulation symbols and the information bits encoded therein.

10. (original) The method of claim 9, further comprising:

performing adaptive equalization when ensuring that the discrete-time receive signal is shaped into a form corresponding to the predetermined overall channel symbol response that is assumed for the TH precoding.

11. (previously amended)The method of claim 1, wherein:

the predetermined overall channel symbol response employed for TH precoding, referred to as h(D), is a finite impulse response (FIR) $h(D)=1+h_1D+h_2D+\cdots h_LD^L$ for some finite positive integer L, or an infinite impulse response (IIR) $h(D)=p(D)/q(D)$; and

$p(D)=1+p_1D+\cdots h_PD^P$ and $q(D)=1+q_1D+\cdots q_QD^Q$ for some finite positive integers P and Q.

12. (original) The method of claim 11, wherein:

$h(D)=(1+D)/(1-\rho D)$ for $0 \ll \rho < 1$.

13. (currently amended) A zero excess bandwidth modulation communication transmitter, the transmitter comprising:

an encoder and symbol mapper that:

encodes a plurality of information bits, thereby generating a plurality of encoded bits; ~~and~~

punctures at least one of the plurality of encoded bits thereby generating a non-punctured plurality of bits that includes a first bit followed by a second bit;

rearranges an order of the non-punctured plurality of ~~encoded~~ bits so that the second bit is followed by the first bit, thereby generating a sequence of discrete-valued modulation symbols;

a TH (Tomlinson-Harashima) precoder that performs precoding of the sequence of discrete-valued modulation symbols according to a predetermined overall channel symbol response having spectral zeroes at edges of a corresponding Nyquist band, thereby generating a plurality of discrete-time transmit signals at a modulation rate;

means to generate a continuous-time transmit signal by appropriate discrete-time filtering, digital-to-analog conversion (DAC), and continuous-time filtering;

wherein the plurality of discrete-time transmit signals is inserted into the means;

wherein the means ensures that the continuous-time transmit signal has spectral zeroes at the edges of the corresponding Nyquist band, which equals a bandwidth of the available transmission band, and that any spectral components outside of the available transmission band are substantially suppressed; and

wherein the filtered, continuous-time transmit signal is launched into the communication channel from the transmit filter.

14. (original) The transmitter of claim 13, wherein:

the predetermined overall channel response is characterized as $h(D) = 1 + h_1 D + h_2 D^2 + \cdots$;

$D = e^{-j2\pi fT} (= z^{-1})$;

f is frequency;

T is an inverse of the bandwidth of the available transmission band;

h_1, h_2, ... are constant valued coefficients; and

$h(D)$ is zero when $D = -1$.

15. (currently amended) The transmitter of claim 13, wherein:

the encoder and symbol mapper maps the rearranged <u>non-punctured</u> plurality of ~~encoded~~ bits into a plurality of modulation symbols according to a symbol constellation and a corresponding mapping function, thereby generating the sequence of discrete-valued modulation symbols.

16. (currently amended) The transmitter of claim 13, wherein:

the encoder and symbol mapper encodes a subset of information bits of the plurality of information bits into the plurality of encoded bits; and

the encoder and symbol mapper maps the <u>rearranged non-punctured</u> plurality of ~~encoded~~ bits and at least one uncoded information bits into a plurality of modulation symbols according to a symbol constellation and a corresponding mapping function, thereby generating the sequence of discrete-valued modulation symbols.

17. (original) The transmitter of claim 13, wherein:

the TH precoder operates on the discrete-valued modulation symbols to perform an inverse filtering operation in accordance with the predetermined overall channel symbol response and executes modulo operations to limit signals within a predetermined signal region, thereby generating the plurality of discrete-time transmit signals at the modulation rate.

18. (original) The transmitter of claim 13, wherein:

the sequence of discrete-valued modulation symbols has a modulation type of at least one of PAM (pulse amplitude modulation), QPSK (quadrature phase shift keying), 16 QAM (quadrature amplitude modulation), and a higher-order QAM.

19. (original) The transmitter of claim 13, wherein:

the encoder and symbol mapper performs encoding of the plurality of information bits, thereby generating the sequence of discrete-valued modulation symbols, that involves at least one of uncoded modulation, TCM (trellis coded modulation), TTCM (turbo trellis coded modulation), LDPC (low density parity check) encoding and modulation, and concatenated encoding and modulation.

20. (original) The transmitter of claim 13, wherein:

the communication transmitter is communicatively coupled to a communication receiver via the communication channel; and

the communication transmitter, the communication receiver, and the communication channel form a communication system.

21. (original) The communication system of claim 20, wherein:

the communication receiver receives a continuous-time receive signal from the communication channel;

the communication receiver converts the continuous-time receive signal into a discrete-time signal using means to perform appropriate continuous-time filtering,

ADC (analog-to-digital conversion), and discrete-time filtering, thereby obtaining a plurality of discrete-time receive signals at the modulation rate;

the communication receiver ensures, within the means to perform appropriate continuous-time filtering, ADC, and discrete-time filtering, that any signal and noise components outside of the available transmission band is suppressed and that the discrete-time receive signal is shaped into a form corresponding to the predetermined overall channel symbol response that is assumed for the TH precoding, and

the communication receiver performs decoding of the plurality of discrete-time receive signals to generate best estimates of the sequence of discrete-valued modulation symbols and the information bits encoded therein.

22. (original) The communication system of claim 21, wherein:

the communication receiver performs adaptive equalization when ensuring that the discrete-time receive signal is shaped into a form corresponding to the predetermined overall channel symbol response that is assumed for the TH precoding.

23. (previously amended)The transmitter of claim 13, wherein:

the predetermined overall channel symbol response employed by the TH precoder, referred to as h(D), is a finite impulse response (FIR) $h(D) = 1 + h_1 D + h_2 D + \cdots h_L D^L$ for some finite positive integer L, or an infinite impulse response (IIR) $h(D) = p(D)/q(D)$; and

$p(D) = 1 + p_1 D + \cdots h_P D^P$ and $q(D) = 1 + q_1 D + \cdots q_Q D^Q$ for some finite positive integers P and Q.

24. (previously amended)The transmitter of claim 23, wherein:

for $0 \ll \rho < 1$.

25. (currently amended) The method of claim 1, further comprising:

after rearranging the order of the non-punctured plurality of ~~encoded~~ bits, puncturing at least one of the rearranged non-punctured plurality of ~~encoded~~ bits

~~thereby generating the sequence of discrete-valued modulation symbols from non-punctured bits within the rearranged plurality of encoded bits~~.

26. (currently amended) The method of claim 1, wherein: ~~further comprising:~~

~~before rearranging the order of the plurality of encoded bits, puncturing at least one of the plurality of encoded bits such that the rearranging the order of the plurality of encoded bits is performed on non-punctured bits within the plurality of encoded bits~~

the sequence of discrete-valued modulation symbols has a modulation type of 32 QAM (quadrature amplitude modulation) (double square).

27. (currently amended) The transmitter of claim 13, wherein:

after rearranging the order of the non-punctured plurality of ~~encoded~~ bits, the encoder and symbol mapper punctures at least one of the rearranged non-punctured plurality of ~~encoded~~ bits ~~thereby generating the sequence of discrete-valued modulation symbols from non-punctured bits within the rearranged plurality of encoded bits~~.

28. (currently amended) The transmitter of claim 13, wherein:

~~before rearranging the order of the plurality of encoded bits, the encoder and symbol mapper punctures at least one of the plurality of encoded bits such that the rearranging the order of the plurality of encoded bits is performed on non-punctured bits within the plurality of encoded bits~~

the sequence of discrete-valued modulation symbols has a modulation type of 32 QAM (quadrature amplitude modulation) (double square).